# NATIONAL VOCATIONAL TRAINING INSTITUTE

## TESTING DIVISION

## TRADE TESTING REGULATIONS AND SYLLABUS

# TRADE: REFRIGERATION AND AIRCONDITIONING SERVICING

## LEVEL: CERTIFICATE ONE

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## A. INTRODUCTION

i. The review of this syllabus has been generally influenced by the demands of industries due to its continuous change as a result of technological advancement and the changing needs of society.

It was also influenced by the TVET reforms under the directions of the new educational reforms with the view to opening up further education and training opportunities to TVET graduates. the certificate ONE syllabus is designed to respond to the following level descriptors:

| QUALIFICATION | KNOWLEDGE LEVEL | SKILLS AND ATTITUDE: |
|---|---|---|
| Certificate 1 | 1. To demonstrate a broad knowledge base incorporating some technical concepts.<br>2. To demonstrate knowledge of the theoretical basis of practical skills.<br>3. To demonstrate knowledge in numeracy, literally, IT and Entrepreneurial skills | 1. Require a wide range of technical skills<br>2. Are applied in a variety of familiar and complex contexts with minimum supervision.<br>3. Require collaboration with others in a team |

ii. The syllabus is aimed at providing Knowledge in the safe handling and uses of Refrigeration and Airconditioning tools and equipments, materials and gasses, troubleshooting, energy saving methods and also uses of environmentally friendly substances.

## B. GENERAL OBJECTIVES

On completion of this course, the trainee should be able to understand and apply:

i) general workshop practice and safety precautions
ii) the handling and use of oxygen/acetylene torch
iii) safe work practice and electrical codes
iv) the principles in Refrigeration/Airconditioning Installation
v) the principles of food preservation
vi) the safe handling of refrigerants and its uses
vii) and appreciate cleanliness after service

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## C. THE COURSE COMPONENTS

Trade Theory
Science and Calculation
Trade Drawing
General Paper
Trade Practical

EXAMINATION: The candidates would be examined in the FIVE components listed in 'C' above.

Practical work must be carefully planned to illustrate application of the theory and to provide maximum opportunity for shop practice, laboratory work and demonstration.

## D. KNOWLEDGE AND SKILLS REQUIREMENT

The prime objective of the programme is to provide knowledge and skills of the trade in a manner that will best meet the needs of the trade as well as industries using professional equipments

## E. ENTRY TO THE COURSE

Minimum education : Must have passed JHS or SHS examination. However, the selection of the students for the course is within the discretion of the head of the institution.

## F. ELIGIBILITY FOR ENTRY TO EXAMINATION

Candidates may enter for examination only as internal candidate; that is those who at the time of entry to the examination are undertaking (or) have already completed the course at an approved establishment.

## G. EXTERNAL EXAMINERS

The practical work of candidates will be assessed by an external examiner appointed by the Trade Testing Commissioner.

## H. EXAMINATION RESULTS AND CERTIFICATES

Each candidate will receive record of performance given the grade of performance for the components Taken. These are:

i) Distinction
ii) Credit
iii) Pass
iv) Referred/Failure

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Certificates would be issued to candidates who pass in all the components.

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**NOTE:**
All Technical and Vocational trainees who aspire to take advantage of the opportunities opened to them in the educational reforms should NOTE that, for a trainee to progress to certificate Two (2) a pass in Certificate One (1) is compulsory.

## I. APPROVAL OF COURSE

Institutions or other establishments intending to prepare trainees for the Examination must apply to:

THE COMMISSIONER
TESTING DIVISION
NVTI HEAD OFFICE
P. O. BOX MB 21, ACCRA

## J. ACKNOWLEDGEMENT

NVTI wishes to acknowledge the preparatory material done by the team of Experts, which have been incorporated into this syllabus.

Ms. Lydia Toku – Diploma (Ed.) Ref.III
Mr. Frank Davies Agamah (B Tech. Ed) UK
Mr. Robert Amontcho (F.T.C.)

Government's desire to improve the lot of Technical/Vocational Training, which led to the preparation of this syllabus, is hereby acknowledged.

## K RECOMMENDED BOOKS

1. Principles of Refrigeration by C. Thomas Oliver
2. Ref and Air-conditioning Tech. (MOTIVATE) By N. Cook
3. Fundamentals of Refrigeration & Airconditioning by Billy Langley
4. Refrigeration and Airconditioning Technology: by William C. Whitman

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5. Processes and Materials by Chapman
6. Tropical Refrigeration & Airconditioning by L.W. Cottel and S. Olarewaju
7. Refrigeration & Airconditioning and Cold Storage by Raymond Gunther
8. Engineering Science by Hughes and Hughes
9. Fundamentals of Automotive Air Conditioning by Boyce H. Dwiggins
10. Engineering Drawing and Construction by L.C. Mott
11. Internet

**LIST OF TOOLS AND EQUIPMENT**

1. Long Nose Plier
2. Plier (Combination)
3. Side Cutting Plier
4. Hacksaw Frame and Blades
5. Hammer (Ball pein)
6. Hammer (Claw)
7. Mallet
8. Flare Nut Wrench
9. Ratchet Box Wrenches
10. Tube Cutter
11. Set of Flaring Tools
12. Set of Swaging Tools
13. Tube Bender (Mechanical)
14. Bending Springs / All Sizes
15. Manifold Gauge/hoses
16. Ohmmeter
17. Voltmeter
18. Clamp-on ammeter
19. Set of screw drivers
20. Set of hexagonal wrenches
21. Set of adjustable wrenches
22. Electric hand drill (power)

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23. Oxy-acetylene welding set/nozzles
24. Vacuum pump
25. Recovery machine
26. Charging scale
27. Leak detectors
28. Belt tension gauge
29. Revit gun
30. Bench vice
31. Various hand files
32. Pinch-off tool
33. Set of allen wrenches
34. Junior hacksaw
35. Thermometer (calibrated and digital)
36. Sling psychrometer
37. Cold chisel (all sizes)
38. Tap/die stocks
39. Wire brushes
40. Concrete cutting machine/cutting disk

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**CERTIFICATE ONE – TRADE THEORY**

| ITEM | TASK | CRITICAL POINTS | SUB POINTS | INSTRUCTIONAL TECHNIQUES |
|---|---|---|---|---|
| 1.0. | GENERAL WORKSHOP PRACTICE | Rules and regulations | • Safety precautions<br>• First Aid<br>• Electric shock<br>• Burns<br>• Workshop arrangement and cleanliness | Discussion on workshop safety rules and regulations |
| 2.0 | TOOLS, INSTRUMENTS AND EQUIPMENT | Common tools, instruments and equipment | • Identification<br>• Selection<br>• Uses<br>• Care<br>• Maintenance | Discussion on uses of common tools, equipment and instrument |
| 3.0 | OXY-ACETYLENE EQUIPMENT | Handling of oxy-acetylene equipment<br>• Transporting<br>• Processes | • Hose colour code<br>• Opening and closing of the regulators<br>• Purpose of check valve<br>• Set the flames i.e.<br>o Neutral flame<br>o Carbonizing flame<br>o Oxidizing flame | Explain parts and functions, and demonstrate various processes |
| 4.0. | PHYSICAL PROPERTIES OF METALS | Properties of metal<br>• Ferrous metal<br>• Non ferrous metal | • Elasticity<br>• Ductility<br>• Toughness<br>• Brittleness etc.<br>E.g. of ferrous metal<br>• Steel, high carbon-steel etc.<br>E.g. Non ferrous metal<br>• Aluminium<br>• Lead<br>• Copper etc. | Identification of ferrous/ non ferrous materials<br><br>Laboratory experiment on material properties |

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**CERTIFICATE ONE – TRADE THEORY**

| ITEM | TASK | CRITICAL POINTS | SUB POINTS | INSTRUCTIONAL TECHNIQUES |
|---|---|---|---|---|
| 5.0. | PLASTICS | Plastic materials | Differentiate between<br>• Thermoplastic plastics<br>• Thermosetting plastics | Discussion with trainee on different types of plastics and uses |
| 6.0. | ELECTRICAL COLOUR CODING | Importance of colour coding | Explain<br>• Colour coding<br>• Single phase<br>• Three phase | Lecture/discussion on colour coding of electrical wires |
| 7.0. | TERMINAL IDENTIFICATION | Identify terminals<br>L. N. E. (Live, Neutral, Earth) | Terminals of :<br>i. Single phase motors<br>ii. Three phase motors | Lecture and discussions |
| 8.0 | OVERLOAD PROTECTORS | Working principle of overload protectors | • Explain the work of overload protectors<br>• Types of overload protectors | Lecture/Discussion using chart or real objects |
| 9.0 | COMPRESSORS | • Types<br>• Classification | Distinguish between<br>• Reciprocating compressor<br>• Rotary compressor<br>• Hermetic compressor<br>• Semi-hermetic compressor | Explain/discuss using real objects as in sub point |
| 10.0 | EVAPORATORS | • Types<br>• Classification Types | Distinguish between:<br>• Flooded<br>• Dry or direct<br>Forms or styles:<br>• Bare tube<br>• Plate surface<br>• Finned | Explain/discuss using chart or real objects |
| 11.0 | CONDENSERS | Type of condensers | Distinguish among<br>• Air cooled<br>• Water cooled<br>• Evaporative | Lecture/discussions with chart or real objects. |

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**CERTIFICATE ONE – TRADE THEORY**

| ITEM | TASK | CRITICAL POINTS | SUB POINTS | INSTRUCTIONAL TECHNIQUES |
|---|---|---|---|---|
| 12.0 | FLOW CONTROLS | Types of flow controls | Explain the various types of flow controls:<br>• Capillary tube<br>• A.E.V<br>• T.E.V.<br>• Hand expansion valve | Lecture/discussion with real objects |
| 13.0 | COOLING TOWERS | The function of a cooling tower | Explain the types:<br>• Natural<br>• Induced or forced | Lecture/discussion and plan tour to Industrial site. |
| 14.0 | REFRIGERANTS | Handling and storage of refrigerants | Explain the following refrigerants:<br>• Hydro carbons<br>• Azeotropic mixtures<br>• Ozone friendly refrigerants<br>• Cylinder colour code of refrigerants<br>• Properties of refrigerants<br>• Specific uses<br>• Chemical name of refrigerant<br>• Chemical formulae of refrigerants<br>• Boiling and freezing point of refrigerants<br>• State the EPA regulations on venting refrigerant vis-à-vis penalty there of. | Lecture and discussion as in sub points |

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**CERTIFICATE ONE – TRADE THEORY**

| ITEM | TASK | CRITICAL POINTS | SUB POINTS | INSTRUCTIONAL TECHNIQUES |
|---|---|---|---|---|
| 15.0 | BASIC REFRIGERATION CYCLE | The working principles of refrigeration cycle | The basic principles of refrigeration<br>• Explain refrigeration cycle<br>• Determine the state and conditions of refrigerant at various point in t he system | Lecture/Demonstration |
| 16.0 | REFRIGERATION ACCESSORIES | The function of the various accessories | The function of the various refrigeration accessories:<br>• Driers<br>• Accumulators<br>• Mufflers<br>• Oil separators<br>• Sight glasses<br>• Check valve<br>• Etc | Lecture/discussion with real objects |
| 17.0 | CHARGING OF OIL | The importance of oil in the compressor | • The methods of charging oil<br>• The purpose of oil in the compressor | Lecture/discussion |
| 18.0 | DEHYDRATION | Understand dehydration | The purpose of:<br>• Adsorption Desiccants<br>• Absorption Desiccants | Lecture/discussion |
| 19.0 | LEAK DETECTION | The various leak detection methods | Explain methods of leak detection:<br>• Soap solution<br>• Halide torch<br>• Litmus paper<br>• Electronic leak detector | Lecture/discussion |
| 20.0 | EVACUATION | Methods of evacuation | • The methods of evacuation<br>• The importance of evacuation | Lecture/discussion |

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**CERTIFICATE ONE – TRADE THEORY**

| ITEM | TASK | CRITICAL POINTS | SUB POINTS | INSTRUCTIONAL TECHNIQUES |
|---|---|---|---|---|
| 21.0 | Charging of Refrigerant | The methods of charging refrigerant | Ways of introducing refrigerant into the system | Lecture/demonstration |
| 22.0 | Scope of Refrigeration | The various applications of refrigeration | The following refrigeration applications<br>• Domestic<br>• Commercial<br>• Industrial<br>• Transport<br>• Air conditioning<br>• Automobile airconditioning | Lecture/Field trips |
| 23.0 | AIRCONDITIONING | The basic principles of air conditioning | Basic principles of air conditioning<br>• Distinguish between the various types of air-conditioning systems<br>• Identify various components and their functions | Discussion/Lecture |
| 24.0 | FOOD PRESERVATION | Methods of food preservation | Methods of food preservation<br>• Refrigeration<br>• Drying<br>• Salting<br>• Smoking<br>• Frying<br>• Storage temperature<br>• Freezing temperature | Lecture/Discussion |
| 25.0 | CLEAN-UPS | Importance of keeping a working area clean | the need of cleaning the customer's premises after work.<br>• Floors<br>• Walls<br>• Ceilings<br>• General working area | Lecture/discuss |

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**CERTIFICATE ONE – TRADE SCIENCE AND CALCULATIONS**

| ITEM | TASK | CRITICAL POINTS | SUB POINTS | INSTRUCTIONAL TECHNIQUES |
|---|---|---|---|---|
| 1.0 | PROCESSES OF REFRIGERATION | Processes of refrigeration cycle | • Define a process<br>• The four processes<br>i. Compression<br>ii. Condensation<br>iii. Expansion<br>iv. Evaporation | Lecture/ Discussion |
| 2.0. | MATTER | Forms of matter and its properties | The various forms of matter and<br>• Liquids<br>• Solids<br>• Gas<br>• Atom<br>• Molecules<br>• Electrons<br>• Elements etc. | *Lecture* |
| 3.0. | BEHAVIOUR OF MATTER | The behaviour of matter | • Define energy<br>• Types of energy<br>Force, motion, work power, horse power, density, volume, mass, specific volume, specific gravity, acceleration, time, velocity | Lecture and laboratory exercise |
| 4.0. | HEAT | The Movement and calculation of heat | • Definition of heat<br>• Transfer of heat conduction, radiation<br>Convection<br>• Kinds of heat sensible heat, lalent heat, specific heat | Lecture and laboratory exercise |
| 5.0. | INTENSITY OF HEAT | Conversion and measurement of temperature | Temperature scales<br>Temperature conversion<br>Types of thermometer | Lecture/Discussion/Demonstration |

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**CERTIFICATE ONE – TRADE SCIENCE AND CALCULATION**

| ITEM | TASK | CRITICAL POINTS | SUB POINTS | INSTRUCTIONAL TECHNIQUES |
|---|---|---|---|---|
| 6.0. | PRESSURE | The various forms of pressure applied to refrigeration and airconditioning | Explain Pressures:<br>• Atmospheric<br>• Gauge<br>• Absolute<br>• Critical | Discuss/Lecture |
| 7.0. | LAWS AFFECTING PRESSURE | Calculate laws affecting refrigeration system | Pressure laws<br>• Boyles<br>• Charles<br>• Dalton's<br>• Pascal<br>• General gas | Discuss /Lecture |
| 8.0. | INTRODUCTION TO PRESSURE HEAT DIAGRAM | The basic application of Mollier chart | i. Define mollier chart<br>ii. The lines on the mollier chart<br>iii. Mollier chart to represent the refrigeration cycle | Define mollier chart and discuss With diagram |
| 9.0. | PSYCHROMETRY | The basic application of psychrometer | • The lines on the psychrometric chart<br>• The sling psychrometer<br>• Psychrometric chart to determine the followings:<br>i. a relative humidity<br>ii. wet bulb temperature<br>iii. dry bulb temperature<br>iv. dew point etc. | Lecture/Discussions/Demonstration With diagram |

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**CERTIFICATE ONE – TRADE SCIENCE AND CALCULATION**

| ITEM | TASK | CRITICAL POINTS | SUB POINTS | INSTRUCTIONAL TECHNIQUES |
|---|---|---|---|---|
| 10.0 | PRINCIPLES OF ELECTRICITY | The basic principles of electricity | • Describe the structure of an atom<br>• Identify negative and positive charges<br>• Explain conductors and insulators<br>• Describe magnetism<br>• Differentiate between direct and alternating current<br>• List unit for<br>i. Current<br>ii. Voltage<br>iii. Resistance<br>• Differentiate between the following circuits:<br>i. Series<br>ii. Parallel<br>• State Ohm's Law<br>• Calculate for electrical power | Lecture/ Discussion/ Demonstration/ Illustration |
| 11.0 | CAPACITORS | The function of capacitors | • Define capacitor<br>• Types of capacitors<br>• Calculate capacitance in both series and parallel circuits<br>• Unit and rating of capacitor | Discussion/ Lecture |
| 12.0 | ELECTRONIC TOOLS | Common tools | Explain the functions of tools:<br>• Screw drivers<br>• Soldering iron<br>• Analogue/digital meters | Lecture/Discussion |

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**CERTIFICATE ONE – SCIENCE AND CALCULATION**

| ITEM | TASK | CRITICAL POINTS | SUB POINTS | INSTRUCTIONAL TECHNIQUES |
|---|---|---|---|---|
| 13.0 | ELECTRONIC COMPONENTS | Test and re-place electronic components | Components:<br>• Resistors<br>• Transistors<br>• Transformers<br>• I.Cs<br>• Printed circuits<br>• Diodes etc. | Discussions and demonstration with real objects |
| 14.0 | SOLDERING AND DE-SOLDERING | Use soldering iron to solder or desolder<br>Leads | Explain how to use soldering iron and sucker to remove or fix electronic components | Discussions/ demonstration |
| 15.0. | CHILLERS | The function of chillers | • Explain the work of chillers<br>• Types of chillers<br>• Application | Lecture<br>Discussion<br>Demonstration/ with site visit |

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**CERTIFICATE ONE – TRADE DRAWING**

| ITEM | TASK | CRITICAL POINTS | SUB POINTS | INSTRUCTIONAL TECHNIQUES |
|---|---|---|---|---|
| 1.0. | INTRODUCTION TO TRADE DRAWING | The importance of trade drawing | Explain the importance of drawing:<br>• Tools<br>• Components<br>• Various symbols | Demonstration with real objects |
| 2.0. | FREEHAND DRAWING | Capable of sketching | Sketching of:<br><u>Tools</u><br>• Plier<br>• Hacksaw blade<br>• Tube cutter<br>• Tube bender<br>• Screw drivers etc.<br><u>Equipment</u><br>• Vacuum pump<br>• Air blower<br>• Welding equipment etc.<br><u>Instruments</u><br>• Voltmeter<br>• Ohmmeter<br>• Ammeter<br>• Sling psychrometer, etc. | Demonstration and guide trainees to practice free hand sketching as in sub point |
| 3.0. | DRAWING OF REFRIGERATION COMPONENTS | The various components | Draw:<br>• Compressors<br>• Condensers<br>• Expansion valves<br>• Evaporators | Demonstration and practice |
| 4.0. | ACCESSORIES | The various accessories | Draw:<br>• Dehydrators<br>• Sight glass<br>• Heat exchangers<br>• Accumulator<br>• Liquid receivers etc. | Demonstration and practice |

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**CERTIFICATE ONE – TRADE DRAWING**

| ITEM | TASK | CRITICAL POINTS | SUB POINTS | INSTRUCTIONAL TECHNIQUES |
|---|---|---|---|---|
| 5.0. | Symbols of Refrigeration | Types of symbols | Mechanical symbols<br>Electrical symbols | Demonstration/ Illustration |
| 6.0. | Basic Gauge Manifold | Gauge manifold parts | Draw gauge manifold and label the internal parts. | Demonstration |
| 7.0. | Basic Refrigeration Cycle | Refrigeration cycle | Draw the basic refrigeration cycle<br>Indicate the flow of refrigerant | Demonstration |
| 8.0. | Refrigeration Cycle | Refrigeration cycle | Draw refrigeration cycle and Incorporate accessories:<br>• Drier<br>• Sight glass<br>• Accumulator<br>• Muffler etc. | Demonstration |
| 9.0. | Connecting Gauge Manifold | The gauge manifold to refrigeration system | • Refrigeration cycle<br>• Manifold gauge<br>• Vacuum pump<br>• Refrigeration cylinder | Demonstration |
| 10.0 | Refrigeration Cycle Using Symbols | Symbols of Refrigeration cycle | Refrigeration circuit using symbols | Demonstration |
| 11.0 | Electrical Refrigeration Circuit | Circuit with symbols | Draw electrical circuit of:<br>• Refrigerators<br>• Air conditioners<br>• Using symbols | Demonstration |

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**CERTIFICATE ONE – TRADE PRACTICALS**

| ITEM | TASK | CRITICAL SKILLS | SUB SKILLS | INSTRUCTIONAL TECHNIQUES |
|---|---|---|---|---|
| 1.0 | GENERAL WORKSHOP PRACTICE | Understand the various workshop safety practice | First aid for:<br>• Burns<br>• Electric shock<br>• Frozen eyes<br>• Gas poisoning | Discuss the various safety measures and practices |
| 2.0. | TOOLS, EQUIPMENT AND INSTRUMENT | Tools for Refrigeration and Airconditioning Servicing | Maintenance of the following tools, equipment and instrument:<br>• tube cutter<br>• vacuum pump<br>• set of pliers<br>• set of adjustable wrenches<br>• oxy-acetylene welding set<br>• voltmeter etc. | Demonstrate the uses and maintenance of the following tools, equipment and instrument |
| 3.0. | TUBE CUTTING | Know how to cut tube | • Measurement of tube<br>• Cutting of tubes<br>• Reaming of tubes | Demonstrate the cutting of tubes |
| 4.0. | BENDING OF COPPER AND STEEL PIPES | Techniques of bending copper and steel pipes | Purpose of copper and steel pipes | Demonstrate the technique of bending |
| 5.0. | FLARING AND SWEDGING OF COPPER PIPES | • Flaring tools<br>• Swedging tools | Handle and use the flaring and swedging tools | Demonstrate safe use of flaring and swedging |
| 6.0. | Hard and Soft Soldering and Brazing Alloys/Flux or Borax | Oxy-acetylene set-up<br>▪ Know how to apply flux<br>▪ Know when and why to apply flux | • Set up and operate oxy-acetylene equipment in a given situation<br>• Adjust the flame:<br>• Carbonizing<br>• Oxidizing<br>• Neutral<br>• Safety precaution should be observed<br>• Apply flux when necessary | Demonstrate the use of oxy-acetylene equipment.<br><br>Sketch different types of flames and its application |

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**CERTIFICATE ONE – TRADE PRACTICALS**

| ITEM | TASK | CRITICAL SKILLS | SUB SKILLS | INSTRUCTIONAL TECHNIQUES |
|---|---|---|---|---|
| 7.0. | CUTTING AND THREADING PIPES | Types of screw thread, taps and dies | Explain and state the functions of:<br>• Taps (taper tap, second tap, plug/button tap)<br>• Tap wrench<br>• Dies and dies stock | Demonstrate thread cutting and cutting with trainee activity |
| 8.0 | PARTS OF REFRIGERATION COMPRESSORS | Parts of refrigeration compressors | Visualize hermetic compressor parts<br>• Reciprocating<br>• Rotary | Demonstrate with real object the parts of hermetic compressor |
| 9.0. | REFRIGERATION SYSTEM | Evacuation methods | Deep evacuation<br>Triple evacuation | Demonstrate with vacuum pump how to evacuate |
| 10.0 | CHARGING OF REFRIGERATION SYSTEM | Charge the refrigeration system with refrigerant and oil | Charge the system with the following:<br>• Refrigerant<br>• Oil | Demonstrate the charging of refrigerant and oil |
| 11.0 | LEAK DETECTION | Various methods of leak detection | Methods:<br>• Immersion<br>• Soap solution<br>• Litmus paper<br>• Halide torch<br>• electronic | Demonstrate various methods |
| 12.0 | THE USE OF GAUGE MANIFOLD | Functions of gauge manifold | • Connect the low and the high pressure gauges<br>• Readings on the compound and pressure gauges | Demonstrate how to use the manifold gauge |
| 13.0 | CONNECTING OF PRESSURE CONTROLS | The connecting of pressure control | • Connect L.P.C in a circuit<br>• Connect H.P.C. in a circuit<br>• Connect dual pressure control | Demonstrate with real object the connection of pressure controls |

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**CERTIFICATE ONE – TRADE PRACTICALS**

| ITEM | TASK | CRITICAL SKILLS | SUB SKILLS | INSTRUCTIONAL TECHNIQUES |
|---|---|---|---|---|
| 14.0 | INSTALLATION OF EXPANSION VALVES | Expansion valve connection | Connect or join:<br>• Capillary tube<br>• A.E.V<br>• T.E.V. | Demonstrate how to connect or join:<br>• Capillary tube<br>• A.E.V<br>• T.E.V |
| 15.0. | HANDLING OF REFRIGERANT OIL | Safe handling of refrigerant oil | • Dryness of the oil<br>• Prevention of contaminants<br>• Storage of oil in a clean and dry container | Explain the handling of refrigerant oil |
| 16.0 | COMPRESSOR TERMINAL IDENTIFICATION | • Single phase compressor<br>• Three phase compressor | Identify terminal of<br>i. single phase compressor<br>ii. three phase compressor | Practice with the ohmmeter Identification of terminals |
| 17.0 | ELECTRICAL SYMBOLS FOR REFRIGERATION | Electrical Symbols | • Symbols of the various electrical components<br>• Fixing of plug tops | Practice the drawing of electrical symbols using the real component. |
| 18.0 | DRAWING OF SIMPLE REFRIGERATION CIRCUIT SYMBOLS | Symbols of refrigeration circuit | • Use symbols to draw refrigeration circuit | Practical drawing using symbols (Schematic drawings) |
| 19.0 | ELECTRICAL INSTRUMENT | Common electrical instruments | Type of electrical instruments:<br>• Ammeter<br>• Voltmeter<br>• Ohmmeter | Demonstrate with real object the use of the instrument |
| 20.0 | CONNECTION OF CAPACITORS | The two methods of capacitor connections | Series and parallel connections | Explain with real object the two connections of capacitors. |

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**CERTIFICATE ONE – TRADE PRACTICALS**

| ITEM | TASK | CRITICAL SKILLS | SUB SKILLS | INSTRUCTIONAL TECHNIQUES |
|---|---|---|---|---|
| 21.0 | MAINTENANCE OF FAULTY FINS | Maintenance of faulty fins | • Cleaning and straightening of fins using fin comb<br>• Burglar proof to protect the fins | Illustrate how to clean, straightening with fin comb |
| 22.0 | MAINTENANCE OF OXY-ACETYLENE TORCH | Oxy-acetylene equipment Parts and care | • Changing of tip<br>• Cleaning hoses<br>• Testing of leaks on the hoses<br>• Cleaning of tips | Explain the maintenance of oxy-acetylene equipment |
| 23.0 | FREEHAND SKETCHING OF COMPONENTS | Refrigeration components | • Draw components of compressor<br>• Condenser<br>• Expansion valve<br>• Evaporator etc. | Practice the drawing of various components |

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**LEVEL – CERTIFICATE ONE – TEST SPECIFICATION TABLE**
**TRADE THEORY (OBJECTIVE)**

| NO | TOPIC | COGNITIVE/ KNOWLEDGE | AFFECTIVE/ UNDERSTANDING | PSYCHOMOTOR/ APPLICATION | TOTAL |
|---|---|---|---|---|---|
| 1. | Tools, Instruments and Equipment | 1 | 1 | 2 | 4 |
| 2. | Physical Properties of Metals | 2 | | 2 | 4 |
| 3. | Terminal Identification | 1 | 1 | 1 | 3 |
| 4. | Compressors | 1 | 1 | 1 | 3 |
| 5. | Condensers | 1 | | 1 | 2 |
| 6. | Flow Controls | 1 | | 1 | 2 |
| 7. | Evaporators | 1 | | 1 | 2 |
| 8. | Refrigerants | 1 | | 1 | 2 |
| 9. | Accessories | 1 | 1 | 1 | 3 |
| 10. | Evacuation | | 1 | | 1 |
| | | | | | 25 |

**LEVEL – CERTIFICATE ONE – TEST SPECIFICATION TABLE**
**TRADE THEORY (SUBJECTIVE)**

| NO | TOPIC | COGNITIVE/ KNOWLEDGE | AFFECTIVE/ UNDERSTANDING | PSYCHOMOTOR/ APPLICATION | TOTAL |
|---|---|---|---|---|---|
| 1. | Airconditioning | 1 | 2 | 2 | 5 |
| 2. | Charging | 1 | 1 | 2 | 4 |
| 3. | Basic Refrigeration Cycle | 1 | 2 | 2 | 5 |
| 4. | Food Preservation | 2 | 1 | | 3 |
| 5. | Dehydration | 1 | 1 | 3 | 5 |
| | | | | | 22 |

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**LEVEL – CERTIFICATE ONE – TEST SPECIFICATION TABLE**
**TRADE SCIENCE AND CALCULATIONS (OBJECTIVES)**

| NO | TOPIC | COGNITIVE/ KNOWLEDGE | AFFECTIVE/ UNDERSTANDING | PSYCHOMOTOR/ APPLICATION | TOTAL |
|---|---|---|---|---|---|
| 1. | Processes of Refrigeration | 1 | 1 | 1 | 3 |
| 2. | Matter | 2 | 1 | 1 | 4 |
| 3. | Heat | 2 | 1 | 1 | 4 |
| 4. | Pressure | 1 | 1 | 2 | 4 |
| 5. | Psychrometry | 1 | - | 1 | 2 |
| 6. | Principle of Electricity | 1 | 1 | 2 | 4 |
| 7. | Capacitors | 1 | - | 1 | 2 |
| 8. | Electronics | 1 | - | | 1 |
| 9. | Chillers | 1 | - | | 1 |
| | | | | | 25 |

**LEVEL – CERTIFICATE ONE – TEST SPECIFICATION TABLE**
**TRADE SCIENCE AND CALCULATIONS (SUBJECTIVES)**

| NO | TOPIC | COGNITIVE/ KNOWLEDGE | AFFECTIVE/ UNDERSTANDING | PSYCHOMOTOR/ APPLICATION | TOTAL |
|---|---|---|---|---|---|
| 1. | Matter | 2 | 2 | 1 | 5 |
| 2. | Heat | 2 | 1 | 2 | 5 |
| 3. | Pressure | 1 | 1 | 1 | 3 |
| 4. | Psychrometery | 2 | 1 | 1 | 4 |
| 5. | Electricity and Electronics | 2 | 2 | 1 | 5 |
| 6. | Chillers | 1 | 1 | 1 | 3 |
| 7. | | | | | 25 |

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**LEVEL – CERTIFICATE ONE – TEST SPECIFICATION TABLE**
**TRADE DRAWING**

| NO | TOPIC | COGNITIVE/ KNOWLEDGE | AFFECTIVE/ UNDERSTANDING | PSYCHOMOTOR/ APPLICATION | TOTAL |
|---|---|---|---|---|---|
| 1. | Introduction to Drawings | 1 | 2 | 2 | 4 |
| 2. | Freehand Sketches | 1 | | 3 | 3 |
| 3. | Refrigeration Components | 1 | 1 | 2 | 3 |
| 4. | Symbols | 2 | | 2 | 4 |
| 5. | Refrigeration Cycle | 1 | 2 | 2 | 5 |
| 6. | Electrical Circuit | 1 | 2 | 2 | 6 |
| 7. | | | | | 25 |

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# NATIONAL VOCATIONAL TRAINING INSTITUTE
# TESTING DIVISION

## TRADE TESTING REGULATIONS AND SYLLABUS

## TRADE: REFRIGERATION AND AIRCONDITIONING SERVICING

## LEVEL: CERTIFICATE TWO

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## A. INTRODUCTION

i. The review of this syllabus has been generally influenced by the demands of industries due to its continuous change as a result of technological advancement and the changing needs of society.

It was also influenced by the TVET reforms under the directions of the new educational reforms with the view to opening up further education and training opportunities to TVET graduates. The certificate TWO syllabus is designed to respond to the following level descriptors:

| QUALIFICATION | KNOWLEDGE LEVEL | SKILLS AND ATTITUDE: |
|---|---|---|
| Certificate II | 1. To demonstrate broad knowledge base with substantial depth in area(s) of study.<br><br>2. To demonstrate a command of analytical interpretation of range of data.<br><br>3. To present results of study accurately and reliably. | 1. Needs varied skills and competencies in different tasks under various contexts.<br><br>2. Require a wide range of technical and supervisory skills.<br><br>3. Would be employed in different contexts. |

ii. The syllabus is aimed at providing advance knowledge in the safe handling and uses of Refrigeration and Airconditioning tools and equipments, materials and gasses, troubleshooting, energy saving methods and also uses of environmentally friendly substances.

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## B. GENERAL OBJECTIVES

On completion of this course, the trainee should be able to understand and apply:

i) the safe methods of defrosting and draining of condensate water from evaporator surfaces
ii) why and how to insulate suction lines.
iii) methods of cleaning the system by dehydration
iv) the systematic method of installing split Air-conditioner and troubleshooting them
v) the functions of transformers
vi) charging of refrigerant and oil in the system
vii) and appreciate customer service and cleanliness

## C. THE COURSE COMPONENTS

Trade Theory
Science and Calculation
Trade Drawing
Trade Practical
General Paper

EXAMINATION: The candidates would be examined in the FIVE components listed in 'C' above.

**EXAMINATION:**
Practical work must be carefully planned to illustrate application of the theory and to provide maximum opportunity for shop practice, laboratory work and demonstration.

## D. KNOWLEDGE AND SKILLS REQUIREMENT

The prime objective of the programme is to provide knowledge and skills of the trade in a manner that will best meet the needs of the trade as well as industries using professional equipments

## E. ENTRY TO THE COURSE

Minimum education: Must have passed the Certificate One (I) examination.

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## F. ELIGIBILITY FOR ENTRY TO EXAMINATION

Candidates may enter for examination only as internal candidate that is those who at the time of entry to the examination are undertaking (or) have already completed the Foundation level and Certificate One at an approved establishment).

## G. EXTERNAL EXAMINERS

The practical work of candidates will be assessed by an external examiner appointed by the Trade Testing Commissioner.

## H. EXAMINATION RESULTS AND CERTIFICATES

Each candidate will receive record of performance given the grade of performance for the components Taken. These are:

ii) Distinction
iii) Credit
iv) Pass
v) Referred/Failure

Certificates would be issued to candidates who pass in all the components.

**NOTE:**

All Technical and Vocational trainees who aspire to take advantage of the opportunities opened to them in the educational reforms should NOTE that, for a trainee to progress to certificate Two (2) a pass in Certificate One (1) is compulsory.

## I. APPROVAL OF COURSE

Institutions or other establishments intending to prepare trainees for the Examination must apply to:

THE COMMISSIONER
TESTING DIVISION
NVTI HEAD OFFICE
P. O. BOX MB 21, ACCRA

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## J. ACKNOWLEDGEMENT

NVTI wishes to acknowledge the team of experts, for preparing the materials which have been incorporated into this syllabus.

Ms. Lydia Toku – Diploma (Ed.) Ref.III
Mr. Frank Davies Agamah B Tech. (Ed) UK
Mr. Robert Amontcho (F.T.C.)

Government's desire to improve the lot of Technical/Vocational Training, which led to the preparation of this syllabus, is hereby acknowledged.

## RECOMMENDED BOOKS

1. Principles of Refrigeration by C. Thomas Oliver
2. Ref and Air-conditioning Tech. (MOTIVET) By N. Cook
3. Fundamentals of Refrigeration & Airconditioning by Billy Langley
4. Refrigeration and Airconditioning Technology: by William C. Whitman
5. Processes and Materials by Chapman
6. Tropical Refrigeration & Airconditioning by L.W. Cottel and S. Olarewaju
7. Refrigeration & Airconditioning and Cold Storage by Raymond Gunther
8. Engineering Science by Hughes and Hughes
9. Fundamentals of Automotive Air Conditioning by Boyce H. Dwiggins
10. Engineering Drawing and Construction by L.C. Mott
11. Internet

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**LIST OF TOOLS AND EQUIPMENT**

1. Long Nose Plier
2. Plier (Combination)
3. Side Cutting Plier
4. Hacksaw Blades
5. Hammer (Ball Pein)
6. Hammer (Claw)
7. Mallet
8. Flare Nut Wrench
9. Ratchet Box Wrenches
10. Tube Cutter
11. Set Of Flaring Tools
12. Set Of Swaging Tools
13. Tube Bender (Mechanical)
14. Bending Springs / All Sizes
15. Manifold Gauge
16. Ohmmeter
17. voltmeter
18. clamp-on ammeter
19. set of screw drivers
20. set of hexagonal wrenches
21. set of adjustable wrenches
22. electric hand drill (power)
23. oxy-acetylene welding set/nozzles
24. vacuum pump
25. recovery machine
26. charging scale
27. lack detectors
28. belt tension gauge
29. revit gun
30. bench vice
31. various hand files
32. pinch-off tool

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33. set of allen wrenches
34. junior hackwas
35. thermometer (calibrated and digital)
36. sling psychrometer
37. cold chisel (all sizes)
38. tap die stocks
39. wire brush

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**CERTIFICATE TWO – TRADE THEORY**

| ITEM | TASK | CRITICAL POINTS | SUB POINTS | INSTRUCTIONAL TECHNIQUES |
|---|---|---|---|---|
| 1.0. | CLEANING | Know how to remove contaminants | Explain how to remove contaminants:<br>• Solids<br>• Liquid and gases | Lecture<br>Discussion |
| 2.0. | DEHYDRATION | The purpose of dehydration | Explain the purpose of drying the system:<br>Type of driers<br>• Adsorption<br>Absorption | Lecture/Demonstration /Discussion |
| 3.0. | CHARGING A SYSTEM | The process of charging a system with gas | Show the correct procedure of charging<br>• Refrigeration oil<br>• Refrigerant | |
| 4.0. | DEFROSTING | The methods of defrosting | Identify the methods of defrosting:<br>• Manual<br>• Electric<br>• Hot gas<br>• Water<br>• Hot-gas thermo bank | Lecture, Demonstration and Discussion |
| 5.0 | DRAINAGE | The angle at which condensate flows | Illustrate how to install drain lines on:<br>Split unit | Lecture |
| 6.0. | INSULATION | The purpose of insulation | • Explain the purpose of insulation materials<br>• Purpose of insulation on pipes, walls and ducts | Demonstration/ Discussion |
| 7.0. | INSTALLATION OF AIRCONDITIONERS | How to install air conditioners | Illustrate the procedure for installing air-conditioning:<br>• Split unit<br>• Central unit<br>• Automobile<br>• Package units | Lecture/Discussion |

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**CERTIFICATE TWO – TRADE THEORY**

| ITEM | TASK | CRITICAL POINTS | SUB POINTS | INSTRUCTIONAL TECHNIQUES |
|---|---|---|---|---|
| 8.0. | TROUBLESHOOTING | The ability to diagnose a unit | Interpret the procedures of diagnosing faults on:<br>• Refrigerating units<br>• Air-conditioning units | Discussion/Lecture |
| 9.0. | ROUTINE SERVICING | Routine servicing | Servicing plan for:<br>• Refrigerators<br>• Airconditioners | |
| 10.0 | TRANSFORMERS | The functions of transformers | • Explain the work of a transformer<br>• Step-down<br>• Step-up<br>• Stabilizer | |
| 11.0 | FOOD PRESERVATION | The importance of food preservation | State various methods of food preservation.<br>• Refrigeration<br>• Drying<br>• Blanching etc.<br>• Freezing temperature<br>• Storage temperature | Lecture/Discussion |
| 12.0 | MICRO-ORGANISMS | The effect of micro-organisms | Elaborate on the types of micro-organisms:<br>Bacteria<br>Moulds<br>Enzymes | Discussion/Lecture |
| 13.0 | CLEAN-UPS | The purpose of cleaning | Clean up all working area after installation and servicing:<br>• Floors<br>• Walls<br>• Ceilings<br>• Etc. | Discussion |

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**CERTIFICATE TWO – TRADE SCIENCE AND CALCULATION**

| ITEM | TASK | CRITICAL POINTS | SUB POINTS | INSTRUCTIONAL TECHNIQUES |
|---|---|---|---|---|
| 1.0. | PRESSURE LAWS | The effect of pressure law on refrigeration system | State and calculate the various pressure laws:<br>Boyles<br>Charles<br>Pascals<br>Dalton's<br>General gas | Illustrations/ Discussions |
| 2.0. | AIRCONDITIONING PROCESSES | The air-conditioning processes | • Humidification<br>• Dehumidification<br>• Filtration<br>• Air movement<br>• Cooling/heating etc | Discussions |
| 3.0. | PRESSURE HEAT DIAGRAM | Use the mollier chart in calculation | Calculate for the following parameters:<br>• Refrigeration effect<br>• Heat of compression<br>• Heat absorbed in the evaporator<br>• Heat rejected in the condenser<br>• Sensible heat<br>• Latent heat etc. | |
| 4.0. | EXPANSION | The expansion of solids, liquids and gases | • Linear expansion<br>• Superficial expansion<br>• Cubical expansion | Illustration/ Discussion |
| 5.0. | PSYCHOMETRIC CHART | Plot and determine the properties of air | • Humidity<br>• Dew point<br>• Grains of moisture<br>• Enthalpy<br>• Relative humidity etc. | Illustration/ Discussion |

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| ITEM | TASK | CRITICAL SKILLS | SUB SKILLS | INSTRUCTIONAL TECHNIQUES |
|---|---|---|---|---|
| 6.0 | HEAT LOAD | The estimation of heat load | • Load sources<br>• Product load<br>• Wall gain load<br>• Supplementary load<br>• Air change load etc. | Illustration/ Discussion |
| 7.0. | ELECTRICAL CIRCUITS | Calculate the resistance of various circuits | Define resistance<br>Calculate the resistance in series, parallel and both series and parallel | Illustration/ Discussion |
| 8.0. | ELECTRICAL CIRCUITS | Define and calculate | Electrical power<br>Electrical energy<br>Inductance<br>Transformer | |
| 9.0. | CAPACITORS | Know the function of capacitor | • Define capacitor<br>• Types of capacitor<br>• Calculate for capacitance<br>i. Series<br>ii. Parallel | Illustration/ Discussion |
| 10.0 | ELECTRONIC TOOLS | Know the work of tools | Explain the functions of tools:<br>• Screw drivers<br>• Soldering iron<br>• Analogue/digital meters | Discussion |
| 11.0 | SOLDERING AND DESOLDERING | Use the soldering iron to solder or desolder | Explain how to use soldering iron and sucker to remove or fix electronic components | Discussion |
| 12.0. | ELECTRONIC COMPONENTS | Test and replace electronic components | Components<br>• Resistors<br>• Capacitors<br>• Transformers<br>• ICS<br>• Printed circuit<br>• Diodes etc. | Discussion |
| 13.0 | CHILLERS | Understand the function of chillers | Explain the purpose of chillers:<br>• Application of chillers<br>• Types of chillers | Discussion` |

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***CERTIFICATE TWO –TRADE DRAWING***

| ITEM | TASK | CRITICAL SKILLS | SUB SKILLS | INSTRUCTIONAL TECHNIQUES |
|---|---|---|---|---|
| 1.0 | INTRODUCTION TO TRADE DRAWING | The importance of trade drawing | • Explain the importance of drawings<br>• Identification of components<br>• Identification of symbols | Demonstration |
| 2.0. | FREEHAND DRAWING | Capable of Drawing and Labelling | Tools:<br>• Equipment<br>• Instruments | Demonstration |
| 3.0. | REFRIGERATION COMPONENTS | Capable of drawing and labeling | • Components<br>• Accessories<br>• Humidifiers<br>• Dehumidifiers | Demonstration |
| 4.0. | SYMBOLS OF REFRIGERATION | Show and interpret drawing | • Mechanical symbols<br>• Electrical symbols | Discussions |
| 5.0. | GAUGE MANIFOLD | Drawing and labeling | Sketch and label the internal construction of a gauge manifold digital or analogue<br>. | |
| 6.0. | COMMERCIAL REFRIGERATION | Sketch refrigeration cycle | Draw refrigeration cycle incorporating:<br>• Evaporative condenser<br>• Cooling tower<br>Flooded evaporator, etc. | |
| 7.0. | ELECTRICAL REFRIGERATION CIRCUITS | Capable of drawing circuit with symbols | Draw electrical circuits<br>• Refrigerators<br>• Airconditioners<br>• Three phase<br>Refrigeration wirings<br>Three phase air conditioning wirings | Demonstration |
| 8.0. | ELECTRICAL COMPONENTS | Draw various components | Drawing of the followings:<br>• Thermostat<br>• Overload protection<br>• Fuse<br>• Breaker etc. | |

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**CERTIFICATE TWO – TRADE PRACTICALS**

| ITEM | TASK | CRITICAL SKILLS | SUB SKILLS | INSTRUCTIONAL TECHNIQUES |
|---|---|---|---|---|
| 1.0 | DEFROSTING | Method of defrosting | Explain the method of defrosting:<br>• manual defrosting<br>• Temperature<br>• Hot gas<br>• Electric<br>• water<br>• Brine | Discuss the methods of defrosting |
| 2.0 | REFRIGERATION ACCESSORIES | The function and maintenance of accessories | Explain the various accessories<br>• Drier<br>• Strainer<br>• Accumulator<br>• Check valve<br>• Moisture indicator<br>• Sight glass<br>• Solenoid valve etc. | Discuss the function and maintenance of accessories using real object |
| 3.0 | DEHYDRATION | The function of driers | Explain the importance of dehydration<br>• Absorption of moisture<br>• Liquid line driers<br>• Suction line driers | Demonstrate how to dehydrate the refrigeration system |
| 4.0 | EVACUATION | The methods of evacuation | Emphasize on the methods of evacuation<br>• Deep evacuation<br>• Triple evacuation | Demonstrate how to evacuate the refrigeration system |
| 5.0 | INSTALLATION OF AIRCONDITIONER | The installation of air conditioners | Explain the procedure for installing air conditioners<br>• Package unit<br>• Split unit<br>• Central unit, etc | Demonstrate the installation of air conditioners |

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**CERTIFICATE TWO - TRADE PRACTICALS**

| ITEM | TASK | CRITICAL SKILLS | SUB SKILLS | INSTRUCTIONAL TECHNIQUES |
|---|---|---|---|---|
| 6.0 | INSULATORS | The function of insulators | Identify various type of insulating materials<br>• Cork<br>• Armmaflex<br>• Fibre glass<br>• Insulation of suction pipes<br>• Discharge ducts, etc | Demonstrate the insulation of suction pipes and ducts |
| 7.0. | REFRIGERATION WIRING | Refrigeration wiring | Do refrigeration wiring involving the following:<br>• Electric heaters<br>• Timer<br>• H. P. C.<br>• L. P. C.<br>• Thermostat<br>• Relays<br>• Overloads, etc | Demonstrate how to wire a refrigeration |
| 8.0 | AIR CONDITIONING WIRING | Air conditioning wiring | Do the wiring of the following:<br>• Packaging unit<br>• Split unit<br>• Central unit<br>• Automobile air conditioners | Demonstrate how to wire air conditioning unit |
| 9.0 | MAINTENANCE OF REFRIGERATING EQUIPMENT | Routine maintenance of equipment in refrigeration | Cleaning of the following:<br>• Filters<br>• Condensers<br>• Evaporators<br>• Straightening of fins<br>• Check pressure<br>• Lubricate moving parts<br>• Carry out efficiency test, etc. | Demonstrate the dehydration of refrigeration system |
| 10.0 | RECOVERY | How to use the recovery machine | Removal of refrigerant from the system<br>• Recovery<br>• Recycling<br>• Reclaiming<br>(R.R.R.) | Demonstrate the use of recovery machine |

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***CERTIFICATE TWO – TRADE PRACTICALS***

| ITEM | TASK | CRITICAL POINTS | SUB POINTS | INSTRUCTIONAL TECHNIQUES |
|---|---|---|---|---|
| 11.0 | RETROFITTING | The change over from one refrigerant to ozone friendly types | • Use of ozone friendly refrigerants in place of hydrocarbons | Demonstrate how to change over from hydrocarbons to ozone friendly refrigerants |
| 12.0 | REPLACEMENT OF FAULTY CIRCUIT BOARD AND REMOTE CONTROL | Replacement of circuit board | Identify, diagnose and replace:<br>• Airconditioner circuit board<br>• Refrigerator circuit board<br>• Remote control | Demonstrate the replacement of circuit boards |
| 13.0 | CLEAN-UPS | Clean the work area after servicing and installation | Clean the following areas:<br>• The walls<br>• Floor<br>• Ceiling<br>• General work | Cleaning-up the work area |

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**LEVEL – CERTIFICATE TWO – TEST SPECIFICATION TABLE**
**TRADE THEORY (OBJECTIVE)**

| NO | TOPIC | COGNITIVE/ KNOWLEDGE | AFFECTIVE/ UNDERSTANDING | PSYCHOMOTOR/ APPLICATION | TOTAL |
|---|---|---|---|---|---|
| 1. | Cleaning | 1 | 1 | 1 | 3 |
| 2. | Dehydration | 1 | 1 | 2 | 4 |
| 3. | Charging a System | 1 | 1 | 2 | 4 |
| 4. | Defrosting | | 2 | 1 | 3 |
| 5. | Insulation | 1 | 1 | 1 | 3 |
| 6. | Installation of Air-conditioners | 1 | 1 | 2 | 4 |
| 7. | Transformers | 1 | | 1 | 2 |
| 8. | Food Preservation and Micro-Organism | | 1 | | 2 |
| | | | | | 25 |

**LEVEL – CERTIFICATE TWO – TEST SPECIFICATION TABLE**
**TRADE THEORY (SUBJECTIVE)**

| NO | TOPIC | COGNITIVE/ KNOWLEDGE | AFFECTIVE/ UNDERSTANDING | PSYCHOMOTOR/ APPLICATION | TOTAL |
|---|---|---|---|---|---|
| 1. | Charging | 2 | 1 | 2 | 5 |
| 2. | Drainage | 1 | 1 | 2 | 4 |
| 3. | Installation of Airconditioners | 1 | 1 | 3 | 5 |
| 4. | Troubleshooting | | 2 | 3 | 5 |
| 5. | Routine Services | 1 | 1 | 2 | 4 |
| 6. | Clean-Ups | 1 | | 1 | 2 |
| 7. | | | | | 25 |

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**LEVEL – CERTIFICATE TWO – TEST SPECIFICATION TABLE**
**(SCIENCE AND CALCULATION - OBJECTIVES)**

| NO | TOPIC | COGNITIVE/ KNOWLEDGE | AFFECTIVE/ UNDERSTANDING | PSYCHOMOTOR/ APPLICATION | TOTAL |
|---|---|---|---|---|---|
| 1. | Pressure Laws | 1 | 1 | 2 | 4 |
| 2. | Airconditioning Processes | 1 | 1 | 1 | 3 |
| 3. | Pressure Heat Diagram (Mollier Chart) | 1 | 1 | 1 | 3 |
| 4. | Expansion of Materials | 1 | 1 | 1 | 3 |
| 5. | Psychometric Chart | 1 | 1 | 1 | 3 |
| 6. | Heat Load | 1 | | 2 | 3 |
| 7. | Electrical Circuit | 1 | 1 | 2 | 4 |
| 8. | Capacitors | 1 | | 1 | 2 |
| | | | | | 25 |

**LEVEL – CERTIFICATE TWO – TEST SPECIFICATION TABLE**
**TRADE SCIENCE AND CALCULATIONS (SUBJECTIVE)**

| NO | TOPIC | COGNITIVE/ KNOWLEDGE | AFFECTIVE/ UNDERSTANDING | PSYCHOMOTOR/ APPLICATION | TOTAL |
|---|---|---|---|---|---|
| 1. | Psychometric Chart | 1 | 1 | 2 | 4 |
| 2. | P.H. Charts | 1 | 1 | 2 | 4 |
| 3. | Chillers | 1 | | 2 | 3 |
| 4. | Electricity and Electronics | 1 | 2 | 2 | 5 |
| 5. | Capacitors | 1 | | 2 | 3 |
| 6. | Soldering and De-soldering | 1 | | 1 | 2 |
| 7. | Pressure Laws | 1 | 1 | 2 | 4 |

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| | | | | | |
|---|---|---|---|---|---|
| | | | | | 25 |

**LEVEL – CERTIFICATE TWO – TEST SPECIFICATION TABLE**
**(TRADE DRAWING)**

| NO | TOPIC | COGNITIVE/ KNOWLEDGE | AFFECTIVE/ UNDERSTANDING | PSYCHOMOTOR/ APPLICATION | TOTAL |
|---|---|---|---|---|---|
| 1. | Introduction to Drawing | 1 | | 2 | 3 |
| 2. | Freehand Drawing | 1 | | 2 | 3 |
| 3. | Refrigeration Components | 1 | 1 | 2 | 4 |
| 4. | Symbols of Refrigeration | 1 | 1 | 2 | 4 |
| 5. | Gauge Manifold | 1 | 1 | 2 | 4 |
| 6. | Commercial Refrigeration | 1 | 1 | 2 | 4 |
| 7. | Electrical Circuits | 1 | 1 | 1 | 3 |
| | | | | | 25 |

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